Table 2.—Minimum temperatures on clear nights in cotton region and fruit region instrument shelters at Medford, Oreg.

| Date. | | Fruit region. | Depar- ture. | |
|---------|--------------|------------------|-----------------|--|
| 1919. | • <i>F</i> . | • F. | ◦ <i>F</i> . | |
| pril 7 | 28, 4 | 29.0 | +0.0 | |
| 8 | 27.4 | 28.0 | +0.0 | |
| 11 | 28.0 | 28.9 | +0. | |
| 12 | 31.7 | 32.1 | +0. | |
| 14 | 2 ჩ. წ | 27.0 | +0. | |
| 20 | 30.8 | 31.1 | +0. | |
| 26 | 31.9 | 32.1 | +0. | |
| [ay 4 | 32.9 | 33.1 | +0. | |
| 5 | 32.0 | 32.7 | +0. | |
| 10 | 32.5 | 33. 2 | +0. | |
| 13 | 33. 0 | 33.6 | +0. | |
| 1920. | 1 |] | _ | |
| pril 11 | 31.8 | 31.8 | 0. | |
| 14 | 34.9 | 34.9 | 0. | |
| 16 | 35.0 | 35.0 | 0. | |
| 17 | | 33.7 | +0. | |
| 18 | | 26.9 | -0. | |
| 20 | 32.0 | 32.0 | 0. | |
| 22 | | 28, 1 | -0. | |
| 23 | .1 26, 0 | 26, 1 | +0. | |
| 24 | | 30.0 | +0. | |
| 25 | . 31.6 | 32.0 | +0 | |
| 29 | | 34, 0 | . 0, | |
| fay 2 | 32.5 | 32.8 | +0. | |
| 3 | 31.0 | 31.4 | +0. | |
| 4 | 31. 1 | 31.4 | +0 | |

Table 3.—Simultaneous current-temperature observations inside and outside fruit region instrument shelter at Medford, Oreg.

| Date and time. | Shelter tempera- ture. | Air tempera ture. | Pepar- ture. | Clo | Da | |
|--|------------------------------|-------------------------|-----------------|------------------|------------------------|----------------------------|
| | | | | Amount. | Kind. | Point. |
| 1919. | | | | | | |
| Apr. 6–7: | • F. | ° F. | ° F. | 0-10. | اسا | |
| 3:43 p. m | 56.0 | 56.0 | 0.0 | 6 | Cu | 32 |
| 4:48 p. m | 52, 2 | 52. 1 | -0.1 | 6 | Cu | 32 |
| 6:46 p. m | 47.7 | 48.5 | +0.8 | 6 | Çu | 35 |
| 7:20 p. m | 40.4 | 45.7 | +0.3 | 7 | Cu | 32 |
| 8:25 p. m | 42.8 | 44.1 | +1.3 | 4 | Cu | 33 |
| 8.58 p. m | 42.1 | 43.0 | +0.9 | 3 | Cu | • |
| 9:28 p. m | 41.0 | 42.1 | +1.1 | | St. Cu | 33 |
| 9:59 p. m | . 40.0 | 40.0 | 0.0 | Few. | Cu | 33 |
| 12:42 a. m | 33.9 | 35.3 | +1.4 | 5 | 0 St | 31 |
| 5:55 a.m | . 32.9 | 33.3 | +0.4 | 1 3 | DI | 31 |
| Apr. 7–8: | | | | | a. a. | |
| 4:51 p. m | 57.2 | 57. 3 | +0.1 | . 8 | Çi. St | 31 |
| 5:33 p. m | 54.1 | 54.2 | +0.1 | 2 | Cu | 30 |
| 7:25 p. m | 46.6 | 46.6 | 0.0 | 0 | 0 | 30 |
| 12:05 a. m | . 34.9 | 35.8 | +0.9 | 0 | 0 | ?" |
| 12:31 a. m | . 34.0 | 35.0 | +1.0 | 0 | 0 | 20 |
| 12:59 a. m | . 33. 2 | 34.1 | +0.9 | 0 | 0 0 0 0 St | 2 |
| 1:30 a. m | . 32, 5 | 33.8 | +1.3 | 0 | 0 | 2 |
| 2:02 a. m | . 32, 1 | 33.0 | +0.9 | 0 3 | 0 | 3. |
| 5:57 a. m | . 28.2 | 29.7 | +1.5 | • | DI | 2 |
| Apr. 10-11: | 1 | | | | l . | ł |
| 4:45 p. m | - 57. 5 | 57.9 | +0.4 | 6 | Cu | |
| 5:50 p. m | . 55.0 | 54.7 | -0.3 | 5 | <u>C</u> u | 1 2 |
| 6:40 p. m | . 52. 2 | 52.0 | -0.2 | 4 | Cu | 1 2 |
| 7:38 p. m | . 47.4 | 47. 5 | +0.1 | 3 3 3 2 | Cu | 2° 2° 2° 2° 2° |
| 8:01 p. m | 45.9 | 46.0 | +0.1 | 3 | Cu Ci. St | 2 |
| 11:30 p. m | . 36.4 | 38.0 | +1.6 | 3 | Ci. St | 2 |
| 12:29 a. m | - 34.8 | 35. 4 | +0.6 | | Ci. St | 2 |
| 1:04 a. m | . 33.9 | 34.7 | +0.8 | Few. | Ci. St | |
| Apr. 10-11: 4:45 p. m | . 29.9 | 32.0 | +2.1 | ! 0 | 0 | 3 |
| Apr. 11–12: | 1 | Ì | ļ | 1 | l | 1 |
| Apr. 11-12: 4:44 p. m | .] 63.0 | 62, 2 | -0.8 | 10 | Ci. St | |
| 5:47 p. m | - 61.1 | 61.0 | -0.1 | 3 | Ci. St | |
| 7:06 p. m | . 53.0 | 52.0 | -1.0 | 3 | Ci. St | , 3 |
| 7:38 p. m | 49.1 | 49.8 | +0.7 | 3 | Ci. St | |
| 8:08 p. m | 48.0 | 49.9 47.2 | +0.9 |] 4 | Ci. St | |
| 8:50 p. m | 46.0 | 47.2 | +1.2 | 5 | CL St | |
| 2:07 a. m | . 37.0 | 38.0 | +1.0 | 6 | CL St | |
| | | 35. 8 | +0.8 | 1 | Ci. St | |
| 3:30 a. m | - 34.0 | 35.8 | +1.8 | 0 | 0 | 3 |
| Apr. 19-20: | 1 | 1 | ì | l . | | 1 |
| 3:43 p. m | . 53.8 | 54.2 | +0.4 | 9 | St. Cu | 4 |
| 4:47 D. M | . 54.1 | 54.0 | -0.1 | 9 | St. Cu | . 3 |
| 5:51 p. m | . 52.6 | 53.0 | +0.4 | 6 | St.Cu | |
| 7:23 p. m | . 49.9 | 50.2 | +0.3 | 3 | St. Cu | |
| 8:34 p. m | \ 45.0 | 45.4 | +0.4 | 1 | \ Cu | -\ 4 |
| 9:00 p. m | \ 44.1 | \ 45.0 | +0.9 | Few. | St.Cu | -\ : |
| 0.00 | 1 40 0 | 44.1 | +1.3 | Few. | St.Cu | - 1 |
| 9:59 p. m | 41.3 | 42.2 | +0.8 | | . St. Cu | |
| 10:27 p. m | 41.6 | 1 43.0 | +1.4 | 4 (| | |
| 11:03 p. m | 40.2 | 2 41.2 | ¥i.0 | 9 (| | |
| 3:21 a. m | 33. | 7 34.3 | +0.0 | 6) (| | •• |
| 9:28 p. m. 9:59 p. m. 10:27 p. m. 11:03 p. m. 3:21 a. m. 5:44 a. m. | 31. 3 | 1 32.5 | i | 4 2 | 3 St. Cu | ·-i |
| May 4-5: | i | 1 | 1 | 1 | 1 | : |
| | 78. | 0 74.5 | 3 -3.1 | 2 | 0 0 | • • <u>•</u> |
| 4.38 n m | 75. | 9 75. | | 1 | Ď Ö | ! |
| 5.90 n m | 73. | | | 8 l | 0 0 | •• |
| 6-32 n m | 67. | | | | n I n | |
| 4:38 p. m. 5:29 p. m. 6:32 p. m. 8:31 p. m. | 56. | | | 6 | 0 0 | ! |
| 8:57 p. m | 53. | | | | 0 0 0 0 | ! |
| 0.01 h. nr | | | | | 0 0 | |
| 2:43 a. m | | 0 00- | 2 +1. | | ŏ ŏ | |

Shelter temperature is current reading of minimum thermometer inside instrument shelter. Air temperature is reading of dry-bulb thermometer of sling psychrometer after whirling.

TABLE 4.—Simultaneous current-temperature observations inside and outside fruit region instrument shelter at Pomona, Calif.

| Date and time. | Shelter tempera- ture. | Air tempera- ture. | Demos | Clouds. | | Dew |
|-------------------------|------------------------------|--------------------------|-----------------|---------|---------|----------------------------------|
| | | | Pepar- ture. | Amount. | Kind. | point. |
| 1918. | | | | | | |
| Dec. 23-24: | ° F. | • F. | • F. | 0-10. | _ | i |
| 7:10 p. m | 35.0 | 36.0 | +1.0 | 0 | Õ | 34 |
| 7:40 p. m | 35.0 | 35.6 | +0.6 | 1 01 | 0 | 34 |
| 8:12 p. m 8:41 p. m | 33.4 | 34.3 | +0.9 | 0 | ő | 32± 31 |
| 9:07 p. m | 32. 2 31. 4 | 32.7 | +0.5 | l ől | ŏ | 31 |
| 9:39 p. m | 31.4 | 32, 2 32, 5 | +0.8 | ا ة | ŏ | 31 |
| 10:08 p. m | 30.2 | 30,6 | +0.6 +0.4 | l ŏl | Ŏ | 29 |
| 10:38 p. m | | 35,0 | +3.1 | l ŏ l | Ō | 32 |
| 11:07 p. m | | 30.9 | 70.0 | O | 0 | 29 |
| 11:39 p. m | 30, 1 | 30.8 | +0.7 | [0] | 0 | 29 |
| 12:07 a. m | 30.0 | 30, 2 | +0.2 | 0 | 0 | 30 |
| 12:42 a. m | 20.0 | 30.0 | +0.3 | 1 1 | A. St. | 30 |
| 1:10 a. m | 29.1 | 30, 1 | +1.0 | 1 1 | A. St. | 30 |
| 1:37 a. m 2:10 a. m | | 29.2 | +0.4 | 0 | 0 | 29 29 |
| 2:37 a. m. | 29.3 29.1 | 31.9 | +2.6 | Ö | ŏ | 27 |
| 3:06 a. m | | 30, 0 20, 8 | +0.9 +1.1 | Ö | ŏ | 27 |
| 3:35 a. m | | 29.7 | +1.1 | ŏ | ľ | 27 |
| 4:06 a. m | 27.5 | 29.5 | ¥1.0 | ě | Ó | 27 |
| 4:35 a. m | 26.7 | 27.9 | +1. ž | 0 | 0 | 26 |
| 5:05 a. m | | 27. 2 | +0.4 | 0 | 0 | 26 |
| 5:37 a. m. | | 29, 8 | +0.8 | , 0 | Ŏ | 25 25 |
| 6:07 a. m | 2000 | 26.7 | +0.8 | 0 | 0 | 25 |
| 6:38 a. m | 201.0 | 27.1 | +1.3 | 0 | l i | 25 |
| | 25. 4 | 26.6 | +1.2 | | " | |
| 1919. Nov. 27–28: | | | } | | | 1 |
| 6:43 p. m | 37.5 | 37.6 | +0.1 | 5 | St. | 24 |
| 7:36 p. m | 35.0 | 35.4 | +0.4 | ő | Ö | 25 |
| 8:27 p. m | | 37.1 | +1.7 | ĺ | 0 | 23 |
| 8:57 p. m | 33.4 | 33.7 | +0.3 | 1 0 | U | 25 |
| 9:27 p. m | 31.8 | 31.7 | -0.1 | 0 | [0 | 23 25 26 26 |
| 10:26 p. m | | 31,0 | +1.5 | 0 | 0 | 20 |
| 11:27 p. m 4:43 a. m | 29.9 26.2 | 31.0 27.6 | +1.1 +1.4 | 0 | ŏ | 23 25 |
| | 20.2 | 21.0 | ļ T. | 1 | | |
| Dec. 13-14: | | | | i . | 0 | 30 |
| 6:30 p. m 6:56 p. m | | 42.1 | +2.0 | | ci. | 29 |
| 7:27 p. m | | 40.7 41.0 | $+1.0 \\ +2.0$ | | ö | |
| 7:57 p. m | | | | 1 = | į ŏ | 27 |
| 8:27 p. m | - 35. 4 | 36.2 | | | 0 | 24 27 28 29 20 21 |
| 8:58 p. m | 34.2 | 35.6 | +1.4 | 1 0 | 0 | 29 |
| 1:27 a. m | | | +1.3 | | Ci. | 20 |
| 1:54 a. m | | 33.6 | +1.5 | | Ci. St. | 20 |
| 4:26 a. m | - 32.3 | 34.1 | +1.8 | 9 | Cl. St. | 20 |
| | 1 | 1 | 1 | 1 | 4 | |

Shelter temperature is current reading of minimum thermometer inside instrument shelter. Air temperature is reading of dry-bulb thermometer of sling psychrometer after whirling.

Table 5.— Minimum temperatures in various locations in lemon trees and in fruit-region shelter.

| Date. | Station numbers.1 | | | | | | |
|---------------|---|--|---|--|---|--|--|
| | 1 | 2 | 3 | 4 | 5 | 6 | |
| 1917. Dec. 18 | *F. 37.0 38.5 34.5 36.9 32.5 37.9 36.0 34.9 33.9 37.6 35.0 37.0 | *F. 36.9 38.0 34.0 36.6 32.0 37.5 42.2 35.2 34.0 33.1 37.0 35.5 36.8 | *F. 37.0 38.1 34.2 36.9 32.6 38.0 42.9 35.6 34.1 33.6 37.1 35.5 | * F (shel- tcr.) 37.0 38.1 34.2 36.9 32.6 37.9 42.5 35.4 34.8 34.0 37.1 35.5 37.0 | * F. 37.0 38.5 34.6 37.0 32.3 38.0 42.9 35.9 34.5 34.5 37.5 | * F. 37.0 38.9 35.0 37.8 33.0 38.0 43.5 36.0 35.1 33.9 38.0 38.0 | |
| 31 1918. | 34.9 | 34.3 | 34.9 | 33.8 | 35.0 | 35.0 | |
| Jan. 1 | 34.0 31.0 | 33.8 | 34.0 30.8 | 34.5 31.0 | 34.1 31.2 | 35.0 31.9 | |
| Average | 35.9 | 35.4 | 35.8 | 35.8 | 36.0 | 36.4 | |

1 Sec fig. 3.

DIFFERENCES BETWEEN THE READINGS OF SHELTERED AND UNSHELTERED THERMOMETERS IN FIELD WORK.

By H. J. Cox.

[Presented before the American Meteorological Society at Chicago, Dec. 29, 1920.]

(Author's abstract.)

The subject of the exposure of thermometers in the field should always be given careful consideration, and

the character of the environment should be fully described, along with the published figures. The readings of unsheltered instruments are actually only the temperatures of the thermometers themselves, but they approximately represent the surface temperature of both the vegetation upon which they rest and of the fruit in the immediate vicinity, and not the temperature of the air. The heat lost by an unsheltered thermometer, especially on clear nights, is greater in a more or less degree than that indicated by a sheltered instrument close by.

During a research in the Wisconsin cranberry marshes minimum thermometers exposed in the open invariably read lower in clear weather than sheltered instruments; and over dense vegetation on clear nights differences ranging from 4 to 9 degrees (F.) were observed.

During a research in the orchards in the Carolina Mountain region minimum thermometers fastened to shelters 5 feet 6 inches above the ground usually read during cloudy weather about the same as thermometers within the shelters at the same height, but in clear weather the unsheltered instruments always read lower, but seldom more than 3 degrees (F); the differences not being as great as in the cranberry marshes because the instruments were farther away from the ground and in sections usually where the vegetation was not so dense. The differences were smaller when fresh to strong winds prevailed.

THE COMPARISON OF THE INDICATIONS OF SOME HOUSE THERMOMETERS IN WINTER. RESULTS OF OBSERVATIONS. 1

By HENRY I. BALDWIN.

(Saranac Lake, N. Y., May 3, 1920.)

SYNOPSIS.

In the comparison of 197 outdoor household thermometers with a sling psychroneter at temperatures ranging from 0° to -30° F., it was found that there was a mean error of 3.2° F. as compared with the psychrometer, the amount of error increasing with decrease in temperature. Of the number tested 120 gave a reading too high, and 68 a reading too low, while 9 were correct at the observed temperature. The greatest error found was 30° F..

It is a common occurrence in a small mountain community that whenever the mercury drops considerably below zero on a still winter morning many conflicting reports are circulated regarding the temperature. There are various popular explanations for these discrepancies, including a vague idea that some parts of a town are colder than others, but there exists little definite knowledge on the subject. It was with a view of ascertaining more definitely the cause of these variations that the following observations were made. It was originally planned to make a complete thermometer census of the village of Saranac Lake, N. Y., under a wide range of temperature conditions, but this was found to be impracticable in the available time. The author fully realizes the limitations of the above observations, owing to the many factors not considered, but hopes that the results may be of some interest if not of much practical value.

Observations were made between 7:15 and 8 a. m., it having previously been determined that no appreciable rise in temperature occurred during that period. The weather conditions were chosen as nearly the same on the different days as possible, cloudless and still mornings being selected. The temperature reading with which the readings of the household thermometers were compared was obtained by taking the mean of three readings of a Green's No. 150 sling psychrometer whirled near the house thermometer. In the following results the readings of this psychrometer are referred to by concession as "standard," and it is assumed that no variation occurred in the instrument during the observations.

To insure this the psychrometer was kept as much as possible at a uniformly low temperature. As the exposure of the thermometers tested differed in nearly every case, and but a few were attached to trees, or objects separated from heated houses, little comparison can be made among them. However, the observations made close to, and applying to one thermometer only, are sufficient for our purposes of showing the errors of individual thermometers. It must, of course, be understood that the arbitrary corrections applied to the different thermometers in the tables hold true only for that particular temperature at which they were checked.

About twice as many thermometers read too high as too low, and it was noticed that it was generally the cheaper alcohol thermometers which read too low, while the majority of the mercurial thermometers read too high. The mean variation from the standard of the 197 thermometers tested was found to be 3.23° F., the error increasing from 2.21° at 0° F. to 4.18° at -28° F. Incidentally some of the series of observations illustrated very well the variations of temperature due to topographic conditions, and shows that these variations are independent of differences in thermometers. In figure 1 the readings of the sling thermometer are plotted beside

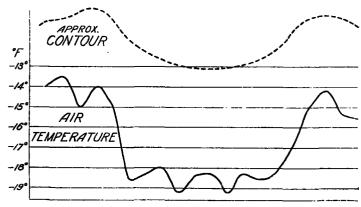


Fig. 1.—Valley profile and corresponding air temperatures near the ground at about su rise on clear, quiet winter mornings. Saranac Lake. N. Y., winter of 1919-20.

an approximate profile of the ground covered in the observations, and demonstrate the effect of topography on the distribution of surface temperatures at about sunrise on clear, quiet, winter mornings.¹

Errors in thermometers arise chiefly from three causes:

Errors in thermometers arise chiefly from three causes: First, from the contraction of the glass and change in the thermometer fluid with age; second, from the differential expansion of the scale and the glass (where the scale is not marked on the glass); and, third, from faulty exposure and ventilation.

The occurrence of minus errors in alcohol thermometers can be explained by the instability of alcohol as a thermometer fluid. It evaporates readily, and hence thermometers are filled at a low temperature, causing a high pressure to be developed when heated. Alcohol is hard to obtain in uniform quality, and has a tendency to form other compounds. However, the coefficient of expansion of alcohol is about 6 times that of mercury,

 $^{^1\,\}rm The$ detailed tables and numerical summaries of the numerical departures are on file at the central office of the Weather Bureau, Washington, D. C.